PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P13594PC/PC/RO	**FOR FURTHER ACTION** See Form PCT/IPEA/416	
International application No. PCT/GB2004/002524	International filing date *(day/month/year)* 11.06.2004	Priority date *(day/month/year)* 14.06.2003
International Patent Classification (IPC) or national classification and IPC A61B5/103, A61B19/00, G01L5/22		
Applicant UNIVERSITY OF DUNDEE et Al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 7 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
14.04.2005	18.08.2005
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Neef, T Telephone No. +31 70 340-4653

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/GB2004/002524

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-16 as originally filed

Claims, Numbers

1-39 received on 23.05.2005 with letter of 20.05.2005

Drawings, Sheets

1/4-4/4 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/GB2004/002524

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-39
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-39
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-39
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1: DE 43 32 580 A (DEUTSCHE AEROSPACE) 30 March 1995 (1995-03-30)

D2: DE 195 33 756 A (FRAUNHOFER GES FORSCHUNG) 13 March 1997 (1997-03-13)

2 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows a tactile sensor assembly with a force transmission member (11,13) and a sensor (12; figures 1, 5, 7: piezoelectric), the force transmission member has a plurality of projections (13) for transmitting an applied force to the sensor, the sensor (12) detects the applied force and outputs an indicative signal (column 1, lines 23- 67).
Also shown is a palpation assembly with a palpation member (1, 2) and a tactile probe with movement relative to the object, both with above tactile sensor assembly and a corresponding method for using the tactile sensor assembly and the palpation assembly; therefore D1 is also the closest prior art to the subject-matter of apparatus claims 25, 31 and method claims 33 and 39.

The subject-matter of claims 1, 25, 31 differs from this known tactile sensor assembly in that :

- the sensor is a **capacitive sensor** that measures a capacitance value when **deformable projections** are deformed by the engagement with the sensor

In D1 the projections themselves are not deformed when pressure is applied, but the projection pushes on a chamber filled with elastic silicone and the membrane of the chamber (upon which the projection is carried) are deformed. Also the capacitive sensor described in the prior art cited by D1 (Suzuki et al.) does have a similar construction.

The subject-matter of claims 1, 25, 31, 33, 39 is therefore new (Article 33(2) PCT).

The problem to be solved can be seen in providing an alternative construction for a pressure sensor.

The solution to this problem proposed in claim 1 and the other claims 25, 31, 33, 39 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
D2 does discloses **deformable** projections (4, figures 1-3;) within a tactile sensor assembly (column 1, lines 8-20) with a force transmission member (3, 4) and a sensor (1, 2, E1, E2; figures 1- 3), however the sensor measures the resistance between electrodes, which decreases with increasing pressure and increasing deformation of the deformable projections, the sensor detects the applied force and outputs an indicative signal (column 3, lines 16-65; figures 2, 3; column 4, lines 6-60).
However D2 points away from the use of **capacitive** sensors (column 1, line 56- column 2, line 4)

Thus there is no disclosure or suggestion of a tactile sensor assembly with a force transmission member having a plurality of **deformable projections**, which are deformed by engagement with a **capacitive sensor**, which outputs a signal indicative thereof.

Therefore the subject-matter of claims 1, 25, 31, 33, 39 does involve an inventive step.

Claims 2- 24, 26- 30, 32, 34-38 are dependent on claims 1, 25, 31, 33 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VIII

Certain observations on the international application

1 The application does not meet the requirements of Article 6 PCT, because claims 1, 25, 31, 33, 39 are not clear and not concise.

1.1 Although apparatus claims 1, 25, 31 and method claims 33, 39 have been drafted as

separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter, e.g. the tactile sensor assembly of claim 1 is also movable relative to an object to be measured. They seem not to involve alternative solutions to a particular problem which could not be covered by a single claim per category of claims, e.g. with the features of apparatus claims 25, 31 as dependent claims as both comprise all the features of claim 1, nor involve the different uses of an apparatus, nor relate to a plurality of inter-related products.

The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT, moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

CLAIMS

1. A tactile sensor assembly comprising:

a force transmission member; and

a sensor comprising a capacitive sensor;

wherein the force transmission member includes a plurality of deformable projections adapted to engage and transmit an applied force to the capacitive sensor, the capacitive sensor being adapted to measure a capacitance value formed when the deformable projections are deformed by engagement with the capacitive sensor when a force is applied to the transmission member, and to output a signal indicative thereof.

2. An assembly as claimed in claim 1 or 2, wherein the area of engagement between the deformable projections and the capacitive sensor increases in accordance with increasing applied force.

3. An assembly as claimed in claim 1, wherein the force transmission member is adapted to transmit forces applied on an object to the sensor.

4. An assembly as claimed in claim 1, 2 or 3, wherein the assembly is adapted for use in surgical procedures.

5. An assembly as claimed in claim 4, wherein the assembly is adapted for use in minimal access surgery (MAS) procedures.

6. An assembly as claimed in any preceding claim, wherein the projections are tapered.

7. An assembly as claimed in claim 6, wherein the projections are conical.

8. An assembly as claimed in any one of claims 1 to 5, wherein the projections are substantially uniform in cross-section.

9. An assembly as claimed in claim 8, wherein the projections are cylindrical.

10. An assembly as claimed in any preceding claim, wherein the sensor is adapted to output an electrical signal.

11. An assembly as claimed in any preceding claim, wherein the sensor is adapted to measure at least one of compression and deflection of the projections.

12. An assembly as claimed in any preceding claim, wherein the sensor is adapted to output data indicative of a degree of deformation of at least one of the projections, to facilitate generation of an image of said at least one deformed projection.

13. An assembly as claimed in any one of claims 1 to 11, wherein the sensor is adapted to output data indicative of a force between the object and the sensor.

14. An assembly as claimed in claim 13, wherein the sensor is adapted to generate voltage data corresponding to the capacitance between the projections and the sensor, and to output data indicative of a corresponding force.

15. An assembly as claimed in claim 13, wherein the sensor is adapted to generate voltage data corresponding to the capacitance between the projections and the sensor, and to output voltage data for subsequent conversion by a processor into data indicating the force exerted on the sensor through the projections.

16. An assembly as claimed in any preceding claim, comprising a processor for receiving data from the sensor.

17. An assembly as claimed in claim 16, when dependent on claim 12, wherein the processor is adapted to determine a distribution of force between the projections and the sensor.

18. An assembly as claimed in claim 16, when dependent upon claim 13, wherein the processor is adapted to process the data and to generate an output indicative of a distribution of force between the projections and the object.

19. An assembly as claimed in any one of claims 16 to 18, wherein the processor includes software adapted to measure deformation of the projections relative to a starting configuration, to determine the force exerted between the object and the sensor.

20. An assembly as claimed in any preceding claim, comprising a display coupled to the sensor, for displaying an image of the projections.

21. An assembly as claimed in claim 20, wherein the display is directly coupled to the sensor by a data link cable.

22. An assembly as claimed in claim 20, including a transmitter and receiver for transmitting data between the display and the sensor, such that the display is indirectly coupled to the sensor.

23. An assembly as claimed in any preceding claim, wherein the force transmission member includes at least 100 projections per square centimetre.

24. An assembly as claimed in any preceding claim, wherein the force transmission member is of an elastically deformable material.

25. A palpation assembly comprising:

a tactile sensor assembly including a force transmission member and a sensor comprising a capacitive sensor, wherein the force transmission member includes a plurality of deformable projections for transmitting an applied force to the capacitive sensor, the capacitive sensor being adapted to measure a capacitance value formed when the deformable projections are deformed by engagement with the capacitive sensor when a force is applied to the transmission member, and to output a signal indicative thereof; and

at least one palpation member for palpating the object.

26. A palpation assembly as claimed in claim 25, wherein the palpation assembly is adapted to palpate the object

between the palpation member and the force transmission member.

27. A palpation assembly as claimed in either of claims 25 or 26, wherein the palpation member comprises an arm adapted to exert a force on the object to palpate the object.

28. A palpation assembly as claimed in any one of claims 25 to 27, wherein the palpation member is moveably mounted relative to the force transmission member and adapted for movement both towards and away from the sensor and in a lateral plane relative to the sensor.

29. A palpation assembly as claimed in any one of claims 25 to 28, wherein the palpation member and the force transmission member are independently moveable relative to each other.

30. A palpation assembly as claimed in any one of claims 25 to 29, wherein the tactile sensor assembly is a tactile sensor assembly as claimed in any one of claims 2 to 24.

31. A tactile probe comprising:

a tactile sensor assembly adapted for movement with respect to an object, the tactile sensor assembly including a force transmission member and a sensor comprising a capacitive sensor, wherein the force transmission member includes a plurality of deformable projections for transmitting an applied force to the capacitive sensor, the capacitive sensor being adapted to measure a capacitance value formed when the deformable projections are deformed by engagement with the

capacitive sensor when a force is applied to the transmission member, and to output a signal indicative thereof.

32. A tactile probe as claimed in clam 31, wherein the tactile sensor assembly is a tactile sensor assembly as claimed in any one of claims 2 to 24.

33. A method of detecting tactile properties of an object, the method comprising the steps of:

providing a tactile sensor assembly comprising a force transmission member and a sensor comprising a capacitive sensor, the force transmission member having a plurality of deformable projections for transmitting an applied force to the capacitive sensor;

locating the deformable projections of the force transmission member in contact with the object;

moving at least one of the object and the force transmission member relative to the other to compress at least one of the deformable projections, to transmit a force to the sensor;

measuring a capacitance value between the compressed deformable projection and the sensor; and

outputting a signal from the sensor indicative of the applied force.

34. A method as claimed in claim 33, comprising measuring deformation of the projections to determine tactile properties of the object.

35. A method as claimed in either of claims 33 or 34, comprising measuring deflection of the projections.

36. A method as claimed in any one of claims 33 to 35, comprising palpating the object to exert a force on the sensor.

37. A method as claimed in any one of claims 33 to 35, comprising bringing the force transmission member into contact with the object and moving the force transmission member relative to the object to transmit a force to the sensor.

38. A method as claimed in any one of claims 35 to 39, comprising displaying an image of the projections.

39. A method of palpating an object, the method comprising the steps of:

providing a tactile sensor assembly comprising a force transmission member and a sensor comprising a capacitive sensor, the force transmission member having a plurality of deformable projections for transmitting an applied force to the sensor;

locating the force transmission member in contact with the object;

palpating the object to compress at least one of the projections, to transmit a force to the sensor;

measuring a capacitance value between the compressed deformable projection and the sensor; and

outputting a signal from the sensor indicative of the applied force.